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RODENT CONTROL



MALARIA
AND EPIDEMIC
DISEASE CONTROL

TRAINING
MANUAL No. 5
FOR ALL PERSONNEL

Allied Forces, SOUTH PACIFIC AREA

Malaria and Epidemic Disease Control

From: The Commander South Pacific.
To: South Pacific Force and South Pacific Area.

Subject: Rodent Control in the South Pacific Area.
Enclosure: (A) Training Manual Number Five.

1. The accompanying Manual on Rodent Control in Military and Naval forces in the South Pacific is published for the information of all forces operating under the South Pacific Command.

2. The information contained therein will be widely published and used as a guide in the control of rodent borne diseases in our forces.

J. H. NEWTON
Commander,
South Pacific Area
and Force.

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Military Importance of Rodent Control

Rodents are of military importance because of their ability to transmit diseases and because of their destruction of military supplies. Within military installations rodents generally find favorable living conditions and a plentiful food supply which usually result in a rapid increase in numbers. With high population densities their damage to property and pest importance presents serious problems and the disease carrying potential is great.

The following diseases are among those known to be carried by these animals:

Bubonic Plague

Bubonic plague is a highly fatal disease transmitted from an infected rat to man by the bite of a rat flea.

Typhus Fever (Murine or Endemic)

Like plague, this disease is transmitted from an infected rat to man by the bite of a rat flea.

Japanese River Fever (Scrub Typhus)

This disease is transmitted to man by the bite of a larval mite. Rats and mice serve as hosts for these mites.

Infectious Jaundice (Weil's Disease)

Man contracts this disease by ingesting food or water contaminated with the urine or feces of infected rats, or through the skin by direct contact with the body or excretions of an infected animal.

Rat Bite Fever

This disease is transmitted to man by the bite of an infected rat. (Numerous reports have been received of military personnel being bitten by rats.)

Tularemia (Rabbit Fever)

This disease is transmitted to man by direct contact with the body of an infected animal or by the bite of a blood-sucking insect which has previously fed on an infected animal.

Rabies

This disease is transmitted to man by the bite of a rabid animal.

Trichinosis

Man is infected with this disease by eating improperly cooked pork containing the cysts of a roundworm. Rats do not transmit this disease directly to man but are an important factor in spreading the disease among swine.

Food Poisoning (Salmonella infections)

Man contracts this disease by eating food which has been contaminated with pathogenic organisms carried on the feet or fur of rats and mice. This disease is particularly apt to be spread by the Norway rat which forages and lives in sewers and other highly unsanitary places.

Rat populations carrying any of the previously mentioned diseases may show no outward signs of infection. However, if at any time numbers of sick or dead rats are found, this fact should be immediately brought to the attention of Malaria and Epidemic Disease Control Units or any available medical or sanitation officer.

Rodents of the South Pacific

In the South Pacific there are four species of rodents, three rats and one mouse (fig. 1), which are known to be important as carriers of disease and which destroy large quantities of military supplies. All these have been introduced to the Pacific islands.

These species may be distinguished from one another by body size and relative length of the tail. Color cannot be depended upon in determining the species. The relative tail length is found by bending the tail sharply forward along the back of the animal and comparing it with the length of the body.

Key to Important South Pacific Rodents

Length of head and body about 3 inches - House mouse (*Mus musculus*)

Length of head and body about 5 inches - Polynesian rat (*Rattus exulans*)

Length of head and body 6 inches or over:

Tail longer than head and body - Black rat (*Rattus rattus* group)

Tail shorter than head and body - Norway rat (*Rattus norvegicus*)

The Norway or brown rat (*Rattus norvegicus*) is found in ports and towns and may occasionally become abundant in localized places in the interior. This large, brown rat is usually numerous around wharves, storehouses, mess halls and quarters housing military personnel. It is not a good climber and lives in burrows in the ground, under floors of buildings built on the ground, under trash piles and in sewer drains and crevices in rock walls or fills. This species has a very high breeding potential and has shown an astonishing ability to adapt itself to variable conditions. Females begin breeding at three to four months of age and under favorable conditions will breed from 6 to 10 times a year, averaging from 8 to 12 young per litter. Females have been known to give birth to as many as 22 young at one time. This species is a known carrier of disease and is very destructive to food and supplies. Control measures are necessary.

The black or roof rat (*Rattus rattus* group) shows more ability to invade areas outside of the immediate vicinity of ports and towns, and is frequently found well into the interior, particularly in and about native villages, farms and coconut

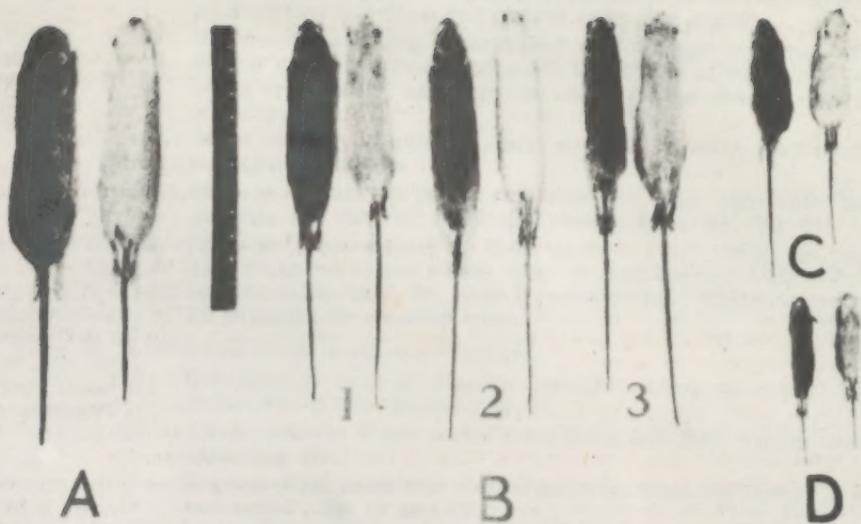


Figure 1. Rodents of epidemic disease and pest importance in the South Pacific.

- A. Norway rat (*Rattus norvegicus*).
- B. Black rat (*Rattus rattus*).
 1. *R. r. rattus*, black back, grey belly.
 2. *R. r. frugivorus*, brown back, white belly.
 3. *R. r. alexandrinus*, brown back, grey belly.
- C. Polynesian rat (*Rattus exulans*).
- D. House mouse (*Mus musculus*).

groves. This species is an excellent climber and often lives in trees and the upper parts of buildings. It is frequently seen running along the rafters of storehouses and other buildings. In other respects the habits of this species are similar to the Norway or brown rat, and it is often found in the same habitat. This species is divided into three subspecies, based on color variations. These are:

- | | |
|-----------------------------------|--|
| <i>Rattus rattus rattus</i> | - Entirely black or sooty black. |
| <i>Rattus rattus alexandrinus</i> | - Greyish brown above and grey below, usually showing no distinct line of color demarcation. |
| <i>Rattus rattus frugivorus</i> | - Brown above and white below, showing a distinct line of color demarcation. |

This species is a known carrier of disease and is also destructive to food and supplies; therefore, it requires control.

The small, brown Polynesian rat (*Rattus exulans*) seldom invades towns and villages but is often abundant in all other types of island habitat. It may occasionally become numerous in military installations located in coconut groves and cleared jungle areas. This rat is not as destructive to food and supplies as the two previously mentioned species but is a potential carrier of disease and should be controlled wherever it becomes abundant.

The house mouse (*Mus musculus*) is found around most human habitations. It causes much damage to food and supplies and is of primary pest importance within most military installations. This species is capable of transmitting many of the same diseases that rats transmit. Control measures are necessary.

In addition to the introduced rats and mice, there are several other species of rodents native to the South Pacific area about which very little is known. However, since these are principally jungle and swamp dwellers and have little contact with man, they are unlikely to be of importance insofar as destruction to supplies or transmission of disease are concerned.

Control Measures

RAT CONTROL

1. ENVIRONMENTAL CONTROL

Rodents must have both food and shelter before they can survive and reproduce. Population densities usually are in direct proportion to the amount of food and shelter available. Much can be done to reduce rodent numbers by protection of food supplies and removal of rodent harbors. Whenever possible the following measures should be taken:

a. Limitation of food supply.

- (1). Keep all garbage cans covered and placed on a platform raised two or three feet above the ground and if possible in a screened enclosure (figs. 2 and 3).
- (2). Make sewer drains inaccessible to rats.
- (3). Store food supplies in rat-proof buildings or on shelves raised at least two feet from the ground (figs. 4, 5 and 6).
- (4). Rat-proof mess halls, galleys and food storage buildings. (Particular attention should be given to fittings of doors and windows, sewer drain openings and entrances for electric lines and water pipes.)
- (5). Store personal foodstuffs, such as candy, cookies and fruit in rat-tight containers.
- (6). Dispose of garbage in an area removed from camp-site. Burn garbage and bury all remaining cans, bottles, etc. (fig. 7).
- (7). Keep coconuts picked up from ground. Place metal rat bands (fig. 8), seven to ten inches wide, around coconut trees. (Bands may be made from No. 10 or larger tin cans.) Wider bands may be required on slanting trees.

b. Limitation of rat shelters or harbors.

- (1). Construct or raise all wooden floored buildings at least 12 to 18 inches above the ground (fig. 9).
- (2). Place concrete floors under mess halls and food storage buildings. (fig. 10).
- (3). Support flys on double roofed tents at least six inches above main roof (figs. 11 and 12).
- (4). Remove all trash and rubbish piles from camp areas; burn and bury as with garbage.
- (5). Remove underbrush for at least 300 yards from the camp area. (This may be done without interfering with the camouflage value of overhead vegetative cover.)
- (6). Keep grass and weeds cut short about camp.

Rodents have very few natural enemies in the South Pacific. The only native predators present are hawks, owls and snakes. Dogs and cats have been introduced and in a few localized areas have helped to control rodent populations.

Under conditions of high population densities, competition between different species of rats is often noted. This conflict between species usually does not result in a decrease in the total rat population in the area but only in a change in population composition.

Environmental controls are not usually sufficient to keep rodent populations in check. Therefore, it is essential that other means be used. Trapping, poisoning and fumigation are accepted as being the most effective methods.

2. TRAPPING

Trapping is a very effective rat control method. Before starting a trapping campaign it is essential that all food available to rats be removed as it is very difficult to trap rats where food is abundant. A large number of traps should be used to make the campaign short and decisive. Traps should be kept clean by scraping or brushing with a wire brush. It is especially important that traps be decontaminated every few days by dipping in boiling water (fig. 13) or burning in a flame, as rats quickly learn to avoid traps if any human odor is present.

The common snap trap is the only trap obtainable from Army quartermasters in the South Pacific. Where snap traps are not immediately available, G. I. cans or oil drums may be utilized as traps. These should be buried level with the surface of the ground and half filled with water. A board should be hinged and balanced on the edge of each can or drum so that in attempting to reach the bait, suspended over the center of the containers, a rat walking out on the balanced board will fall into the water when it tips down.

The various species of rats have distinctly different life habits and, therefore, success in trapping requires the use of different baits and different trapping procedures.

a. Baits and baiting

The selection of baits for trapping is very important. A wide variety of foods may be used; however, food preferences often differ among the various species of rats, and animals of the same species may also prefer different types of food. For best results, it is advisable to use more than one kind of bait at a time. Values of various baits with the important rats species in the South Pacific has been determined as listed in Table I.



Figure 2. A simple, easily constructed garbage platform which effectively limits rodent food supply.



Figure 3. Enclosed, rat-proof garbage hut. Screening aids in fly control as well as in rodent control.



Figure 4. Improper method of storing supplies. Boxes piled together on the floor create excellent rat harbors.



Figure 5. Proper method of storing supplies. Rat harbors are eliminated.



Figure 6. Proper method of storing baked goods in buildings difficult to rat-proof.



Figure 7. Garbage disposal trench. Fire destroys the burnable material and as the trench is progressively filled the remaining debris is covered with dirt by bulldozers.



Figure 8. Metal bands properly placed on coconut trees



Figure 9. Tents properly constructed with wooden floors raised at least 12 to 18 inches above the ground.



Figure 10. Improperly constructed food storage tent. The floor should be of concrete or raised 12 to 18 inches above the ground.



Figure 11. Double-roofed tent with improperly hung fly, providing excellent harbors for rats.



Figure 12. Double-roofed tent with properly raised fly, eliminating any possibility of rat harbors.



Figure 13. Decontaminating traps by dipping in boiling water.

TABLE I
COMPARATIVE VALUES OF AVAILABLE BAITS FOR RATS IN THE
SOUTH PACIFIC

Kind of Bait	Norway Rat	Black Rat	Polynesian Rat
Fresh coconut	Excellent	Excellent	Excellent
Fresh meat	Excellent	Excellent	Excellent
Peanut butter	Excellent	Excellent	Excellent
Cheese	Poor	Poor	Undertermined
Salmon	Poor	Poor	Undertermined
Corned beef	Poor	Good	Undertermined
Oatmeal & peanut butter	Excellent	Excellent	Excellent
Copra (dried coconut)	Excellent	Poor	Undertermined

Note—(Good results have also been reported using papaya and melon as trap baits.)

All baits except coconut and peanut butter should be changed daily. Baits must be firmly attached to trap triggers. Baits and traps should be handled as little as possible with the bare hands; rubber gloves should be worn if available.

When native help is used, it is imperative that traps be picked up daily for counting and cleaning. Some trap loss should be expected, but if this is over two or three percent per day, theft, laziness or general incompetence should be suspected and an investigation promptly made.

b. Placing of traps

Rats rely on concealment and prefer to feed and rest in dimly lighted, well protected places. It is important that traps be placed under or near protective cover so that rats can reach them without exposing themselves.

Norway or brown rats are ground dwellers. Only rarely are they found above the first floor in a house and then only when access to the upper floor is exceptionally easy. Traps to catch this species should be set on the ground near protective cover, close to walls, behind objects, or wherever rat sign is evident. A rat will stop to feed wherever it will stop to defecate.

Black or roof rats are natural climbers. While not arboreal in a strict sense, they have an affinity for high places and their ability to climb over and along lines, limbs and other precarious surfaces presents a different trapping problem. Traps available in the South Pacific must be set on a flat surface and are not particularly satisfactory for trapping these rats. Although more rats of this species will be caught if traps are set above the ground level, many rats can also be caught along the ground and traps should be set wherever rat sign appears.

Polyesian rats are found along the jungle edge, around garden patches and material piles covered with tarpaulins. Traps for this species should be set on the ground near feeding areas or runs.

3. FUMIGATION

This method of rat control is effective wherever it can be properly employed. However, it can only be used in rat burrows and harbors where a sufficient concentration of the gas can be obtained for a good kill. Since rats live in many places where this method cannot be used, fumigation is most effective when combined with other control methods.

Calcium cyanide dust (Cyanogas), available to the Armed Forces, is a very effective fumigant. It gives off hydrocyanic or prussic acid gas very rapidly upon contact with moisture in the air. This gas is extremely poisonous and is destructive to all animal life when used in sufficient concentration. Because of the dangers involved, this method of control should be used only by personnel trained to handle fumigants or under supervision of such personnel.

Calcium cyanide dust is forced into rat burrows or other harbors by means of a portable dusting pump. A few strokes of the pump will fill most burrows with the smoke-like dust which will emerge from all connecting openings and thus indicate the extent of the system. All openings through which the dust escapes should be closed with mud, sod or other material. Dusting should be done on a still day so that drafts of air will not carry the gas away. Extreme caution must be used when fumigating materials are employed.

Precautions that should be taken are as follows:

- (1) Do not transfer dust from containers to dust guns indoors.
- (2) Avoid breathing gas fumes given off.
- (3) Wash hands after handling the dust.
- (4) After removing part of the dust, tightly seal container to prevent deterioration.
- (5) Be sure to empty dust guns after use.

Under certain circumstances the exhaust from gasoline engines (carbon monoxide) can be successfully used as a fumigant for rodent control in the South Pacific.

4. POISONING

The most effective method of destroying rats is by the use of poison. However, if a high degree of success is to be expected, nearly the whole population must be killed the first time the poisoned bait is distributed. If only part of the rats are killed the others become suspicious and will not readily accept poisoned bait. It is, therefore, essential that care be exercised in selecting, mixing and distributing baits. It is especially important to use baits that are known to be attractive to the particular rat population which is to be controlled. If repeated poisoning is necessary, both the kind of bait and the kind of poison should be changed with each treatment.

a. Poisons

Barium carbonate—Barium carbonate is a relatively mild poison which yields good results. At present it is the only rat poison available in large quantities in the South Pacific.

Red squill—Red squill is a popular poison for use in controlling rats. It is relatively safe to handle. When red squill is eaten by domestic animals or man it induces vomiting and acts as its own antidote. Since rats cannot vomit, red squill produces fatal results. Different lots of red squill may vary in toxicity and it is important to obtain a red squill powder of known potency.

Thallium sulfate—Thallium sulfate is a very effective rat poison. However, being odorless, tasteless and very powerful, this metallic poison is extremely dangerous to domestic animals and man. This poison may be absorbed through the skin and continuous handling may produce a chronic case of poisoning. Due to the extreme danger attending its use, this poison should be employed only under the supervision of trained personnel. Rubber gloves should always be worn when handling, mixing or distributing thallium sulfate baits.

Arsenic trioxide (white arsenic)—Arsenic trioxide is considered a fairly good rat poison, the chief objection being that rats soon learn to avoid it. Only the finely ground grade should be used.

Phosphorous—Phosphorous is used extensively in rat control but is considered only a fair lethal agent. The baits must be kept moist which is often difficult in wide scale operations. Some forms of the poison present a fire hazard. Phosphorous paste, in which the phosphorous particles are ground to almost colloidal fineness, often gives good results. Phosphorous in this form also produces only a negligible fire hazard.

Strychnine alkaloid—Strychnine is a very powerful, quick-acting poison but is generally not taken well by rats because of its bitter taste which is difficult to disguise. However, it is a very effective mouse poison and is recommended for this purpose when available.

Table II has been prepared to assist in selecting available poisons and obtaining the proper strength of poisons in the bait formulas.

TABLE II

PROPORTION OF POISON TO USE WITH BAIT FOR RAT CONTROL

Kind of Poison	Killing Time (Hours)	Poison - Ounces	Bait - Pounds
Barium carbonate	24	4	1 ^{1/4}
Red squill	24-100	16	9
Thallium sulfate	72	1	4
Arsenic trioxide	24	1	2
Strychnine alkaloid	1	1	10

b. Recommended bait formulas

Formula No. 1.

Bread Crumbs

Bread has proven to be a very successful bait when used with any of the above poisons. Old or fresh loaves of bread may be prepared for mixing by breaking and crumbling, or by slicing, drying and grinding. Do not use mouldy bread. Mix the selected poison with the bread, with proportions indicated in Table II, and add water until the mixture will form a ball when compressed in the hand. Bread is easy to obtain, and dry bread crumbs will keep indefinitely if kept dry in a tight container.

Formula No. 2.

Bread crumbs or cereal.....	35 lbs.
Peanut butter.....	5 lbs.
Molasses.....	5 lbs.

Add the selected poison to the peanut butter and stir into a mixture of the other ingredients. This bait will remain acceptable to rats for several weeks when placed in a dry place.

Formula No. 3.

Bread crumbs or cereals.....	10 lbs.
Ground coconut or copra.....	10 lbs.
Glycerine or coconut oil.....	20 oz.

Add the selected poison to the oil and stir into a mixture of the other ingredients.

Formula No. 4.

Bread crumbs or cereals.....	10 lbs.
Fresh ground meat.....	10 lbs.
Glycerine.....	10 oz.

Stir the selected poison into the fresh ground meat and add to a thorough mixture of the other ingredients. Mix thoroughly.

Formula No. 5.

Bread crumbs or cereals.....	4 lbs.
Finely ground cheese.....	1 lb.
Mineral oil.....	5 oz.

Add the selected poison to the oil and stir thoroughly into a mixture of the other ingredients. This bait will keep for several months and, even though it may become rancid, it will remain acceptable to rats.

Formula No. 6.

Bread crumbs or cereals.....	7 lbs.
Ground fish or canned salmon.....	3 lbs.

Add the selected poison to the fish and stir in the cereal or bread crumbs until a uniform mixture is produced. Add water to the mixture until the bait will form a ball when compressed in the hand.

c. Pre-baiting

In preparing to poison rats it is advisable to prebait the area with unpoisoned foods. Several kinds of bait should first be tried in order to determine which is most readily taken. The preferred food should then be distributed freely for several nights so that the rats will become accustomed to taking the bait put out for them. When poison is distributed, this same food should be used as a base for the poisoned bait. Pre-baiting aids in selection of acceptable baits and overcomes the normal reluctance of rats to take food the first time it becomes available.

The foods used for pre-baiting should be selected from the following classes. (At least one of each class should be tried if available.)

Cereals - bread, oatmeal, cornmeal, grains, etc.

Meats - hamburger, liver, salmon, fresh ground fish, etc.

Fruits and vegetables - melons, bananas, coconut, peanut butter, etc.

The use of feeder stations (fig. 14) is recommended as an aid to pre-baiting and poisoning. These stations protect the bait from domestic animals and also from the weather. In addition, these provide sheltered places for rats to eat, thus increasing their confidence. Permanent feeder stations should be maintained near bakeries, mess halls, food storage buildings or other places which are apt to be infested with rats. Food kept in these feeder stations should be periodically poisoned, thereby maintaining constant rat control. Watering stations, which can be poisoned, may also be used to attract rats where rainfall is limited. If boxes or cans are used for feeder stations these should be constructed with at least two entrances.

d. Preparation and distribution of bait.

The consistency of poisoned baits should be such that the bait can be cut or shaped into small balls or flat cakes. About one teaspoonful or a ball one half inch in diameter is about right. Baits should never be larger than golf ball size. Soft, well-moistened baits are generally more attractive to rats than hard, dry baits. It is preferable to prepare baits in such a manner that a rat can pick them up and carry them to a hole in order to investigate and eat at leisure. Thus, wrapping baits in paper like candy "kisses" is an excellent technique. (Baits wrapped in this manner are often called "torpedoes".) This procedure may not always be practical in the South Pacific where there is often a shortage of manpower. If there is an abundance of native labor, or if a working party can be obtained, the extra effort will be warranted.

Baits should not be mixed or handled with the bare hands as many rats will refuse baits if any human odor can be detected. In mixing baits it is best to use a spoon or paddle which leaves no odor (fig. 15). Rubber gloves should be worn when baits are distributed or whenever it is necessary to put the hands in the bait.

Baits should always be distributed in the late afternoon and prepared as short a time before as is practical.



Figure 14. Two types of feeder stations easily made from available materials

As with traps, poisoned baits should be placed in areas known to be frequented by rats, such as runways leading from rat dens to watering or feeding areas. Rats may be attracted, as suggested previously, by pre-baiting and the establishment of feeding and watering stations.

Baits may be placed singly or in groups up to five pieces. Ordinarily poisoning will be more effective when a large number of baits are used. Single baits or groups of baits should be placed from 5 to 15 feet apart.

e. Evaluating results of poisoning.

Only under the most favorable conditions will more than 15 to 20 percent of the baits be taken. Frequently wholly satisfactory results are obtained when rats take not more than five percent of the baits distributed.

In order to readily check the percentage of success when using poisoned baits or "torpedoes", it has been found advisable to place 3 to 5 baits at each baiting site and to put out even numbers of 50, 100, etc., baits in each area being poisoned. For example, an area may be poisoned with 100 caches containing five torpedoes each. On the following morning the caches in the area are inspected and a record made of the number of baits taken from the caches actually counted. By comparing the number of baits taken from the caches counted with those still remaining, the percentage of poisoning success can be easily determined. Once the value of a type of poisoned bait has been established for a particular rat population, the number of baits taken may be considered an indication of the number of rats killed. However, it is almost impossible to accurately determine the number of rats actually killed in a poisoning campaign. Besides percentage of success, checking will reveal any disturbances of the baits by cats, dogs, cockroaches or ants.

f. Precautions recommended.

With the exception of red squill, poisons used in rat control are dangerous to domestic animals. If there is danger of these animals picking up the baits, they should be confined during the poisoning campaign and all remaining baits should be removed before the animals are released. The use of feeder stations will do much to eliminate this problem. Ordinarily, well fed pets about military organizations will not take poisoned baits. Native pets almost always do. Owners of pets should always be warned, but shortages of manpower and exigency of the service require that the rats be destroyed as quickly and economically as possible. Where a civilian population is concerned, as in some island towns, poisons other than red squill must be used with care or not at all.

MOUSE CONTROL

Mice may be caught in the snap traps available for rat control if these traps are set lightly. The sensitivity of rat traps set for mice can be improved by releasing the tension on one side of the spring. Small pieces of chocolate candy make excellent baits for mice.

Poisoning is a much more efficient method when control on a large scale is necessary. Two kinds of poisoned baits may be used. One is a stable bait that



Figure 15. Mixing bait in quonset hut tub.

will remain effective for a long period of time, and the other is a fresh bait to be prepared and used at once.

A. Stable baits.

The use of stable baits is often desired for continued mouse control in food storage buildings, mess halls and living quarters. The following formula is recommended:

Whole wheat or oats.....	10 lbs.
Heavy corn syrup.....	1 pt.
Gloss starch.....	1 tbsp.
Baking soda.....	1 oz.
Glycerine or petrolatum.....	1 tbsp.
Powdered strychnine alkaloid.....	1 oz.

Mix the starch in one-fourth teacupful of cold water and stir into three-fourths pint of boiling water to make a thin, clear paste. Mix the strychnine alkaloid with baking soda and stir into the starch to a smooth, creamy mass free of lumps. Stir in corn syrup and glycerine or petrolatum. Apply to whole wheat or oats and mix thoroughly to coat each kernel. Spread on paper to dry. Other poisons do not work as satisfactorily as strychnine in this formula.

Stable baits will last indefinitely if kept dry in a tight container. Such baits should be put out in small piles, about a teaspoonful each, in the places mice are known to frequent. While very effective in controlling mice, these baits are not readily taken by rats.

B. Fresh baits.

The following formulas are recommended for the use of fresh bait materials with available poisons:

Formula No. 1.

Fresh coconut, bananas or sweet potatoes.....	5 lbs.
Powdered strychnine alkaloid.....	1 oz.

Dice fresh coconut, bananas or sweet potatoes into one-half inch cubes and dust with powdered strychnine alkaloid. Mix thoroughly. Other poisons may be substituted for the strychnine, using the proportion of poison to bait listed in Table II.

Formula No. 2.

Hamburger or other fresh, ground meat.....	10 lbs.
White arsenic.....	2 oz.

Thoroughly mix white arsenic powder with fresh hamburger or other ground, fresh meat. Other poisons listed in Table II may be substituted for the white arsenic. When danger to cats and dogs must be considered, great care should be exercised in using poisoned meat baits.

These fresh baits are effective in controlling both rats and mice. For best results, fresh baits should be prepared and distributed in the late afternoon.

Ship-Shore Rodent Control

The control of ship to shore and shore to ship rodent movements is one of the most important epidemic disease control objectives. Shore based personnel must be continually concerned with ship isolation measures because personnel attached to ships temporarily docked have little or no interest in the health of the base and are usually too busy to provide rat guards or to place them properly. Large signs should be placed conspicuously on wharves and piers calling attention to rodent control regulations (fig. 16).

The following precautions should be taken at every port:

- (1) Rat guards or shields (fig. 17) should be maintained at all times on all lines connecting ships with wharves or with other ships. These guards should be so placed that they effectively prevent the use of such lines for rat travel. Consideration in placing the guards should be given the ability of rats to jump from one line to another.
- (2) Light clusters (fig. 17) should illuminate bow and stern lines at night.
- (3) All landing stages and gangways between ships and wharves should be removed or raised between sunset and sunrise unless a watch is present at all times.
- (4) Cargo nets should be removed from the wharves during darkness unless cargo is being worked.

APPENDIX

ORGANIZATION FOR RODENT CONTROL

Malaria and Epidemic Control Units are established at all South Pacific Area bases. These units are responsible for the control and suppression of epidemic diseases, including those diseases with rodent relationships. Trained and experienced rodent control personnel is available through these units.

Each military activity should assign to work in cooperation with this rodent control group sufficient personnel to carry out a successful control program in its own organization. One or more men in each organization, no matter how small, should become as proficient as possible in rodent control. When the organization moves into a forward area this trained personnel can deal with rodent control problems early, thus preventing needless waste of critical supplies or the spread of epidemic disease at a time when sanitation and disease control is necessarily at a low ebb. Such personnel among the various units also serves as a reservoir of trained manpower in case of an outbreak of rodent borne epidemic disease. If possible, persons should be selected who are interested in this type of work or have had some experience in rodent control.



Figure 16. Signs used to call attention to existing port rodent control regulations.



Figure 17. Ship at dock with rat guards and cluster light properly placed

PROCUREMENT OF SUPPLIES

The central procurement, distribution and issue of pest control supplies for all Armed Forces located in the South Pacific area has been assigned to Army Services of Supply.

Service Command Quartermasters and Base Quartermasters at those bases where no Service Command has been organized, in cooperation with Base Malaria Control Officers, receive, store and distribute these supplies to all Armed Forces at each base. Naval Supply Officers, Marine Quartermasters and New Zealand Supply Officers may obtain their stocks in bulk from Base or Service Command Quartermasters at each base by requisition on Army form No. 400.

The Naval Supply Depots at the various South Pacific Bases usually have a supply of traps for forces afloat, but they are not responsible for pest control supplies for land bases Naval units.

Each unit has the authority to draw the supplies needed direct from the Army Base or Service Command Quartermaster through their own supply officer.

All armed forces are authorized to draw pest control supplies on the basis of manpower as follows:

Traps, rat spring, ea.	50 per 1000 men per three months
Barium carbonate, 1 lb.	2 per 1000 men per month
Calcium cyanide, 5 lb.	1 per 1000 men per month

At the present time the above mentioned supplies are the only rodent control materials furnished the Armed Forces in the South Pacific on a manpower basis. Red squill and thallium sulfate rat poisons are expected to be added to the list. From time to time Naval supply facilities have stocked red squill, thallium sulfate and rat traps. It is advisable to check this source at the various bases to supplement supplies coming through Army channels.

ANTIDOTES

The following antidotes are listed for poisons used in rodent control operations. In case of accident the specific antidote should be administered at once.

BARIUM CARBONATE - Give an emetic consisting of either mustard or salt dissolved in warm water or induce vomiting by inserting the finger in back of the throat. Follow vomiting with a liberal quantity of Epsom or Glauber's salts.

STRYCHNINE - Administer emetic until free vomiting is induced. Evacuate stomach by washing it out with a solution of iodine. (This solution must be removed from the stomach.) If convulsions are present, inhalations of ether or chloroform should be given. Artificial respiration should be applied if necessary. Secure medical aid.

THALLIUM SULFATE - Wash stomach with copious quantity of 1% sodium or potassium iodide in water. Give cathartics (avoid sulfates); apply external heat and artificial respiration if necessary. Give stimulants. Secure medical aid.

ARSENIC TRIOXIDE - Wash stomach promptly with quantities of warm water; give milk of magnesia or castor oil. Secure medical aid.

PHOSPHOROUS - Wash out stomach thoroughly with $\frac{1}{2}\%$ solution of copper sulfate, potassium permanganate (1 to 1000), or dilute hydrogen peroxide. Give Epsom salts.

CALCIUM CYANIDE FUMES - Breathe fresh air. Apply artificial respiration if necessary. Slowly inhale fumes of amyl nitrite, holding ampule near nose of patient 15 to 30 seconds every three minutes rather than continuously.

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